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GENCORP AEROJET

Earth Observing System/ Advanced Microwave Sounding Unit-A (EOS/AMSU-A) Software Concept Document

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Goddard Space Flight Center
Greenbelt, Maryland 20771

Submitted by:

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13. ABSTRACT *(Maximum 200 words)*

This document presents the concept for two separate but closely related software systems. The first is the Special Test Equipment (STE) software used at Aerojet for AMSU-A instrument testing, and the second is the Workstation software used at the spacecraft integration facility to monitor the AMSU-A instrument when installed on the spacecraft.

The primary use of the STE software is to monitor the data output from the AMSU-A instruments, to command the instruments, and to perform automated thermal-vacuum calibration testing.

The primary use of the Workstation software is to monitor the AMSU-A instrument's performance through an Ethernet link during the instrument/spacecraft integration process.

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Section 1

INTRODUCTION

1.1 Identification

This is the *Software Concept Document* for the software to be used in the Earth Observing System (EOS) /Advanced Microwave Sounding Unit-A (AMSU-A) system Ground Support Equipment. This document is submitted in response to Contract NAS 5-32314, CDRL 306-1.

1.2 Scope

This document describes the software concept for the EOS/AMSU-A program Ground Support Equipment.

1.3 Purpose and Objectives

The purpose of the *Software Concept Document* is to define the software's purpose and scope, its goals and objectives, and its capabilities and characteristics from a conceptual standpoint.

1.4 Document Status and Schedule

This is the initial and only submittal of the EOS/AMSU-A *Software Concept Document.*

1.5 Documentation Organization

The EOS/AMSU-A Software Documentation Tree is as shown in Figure 1.

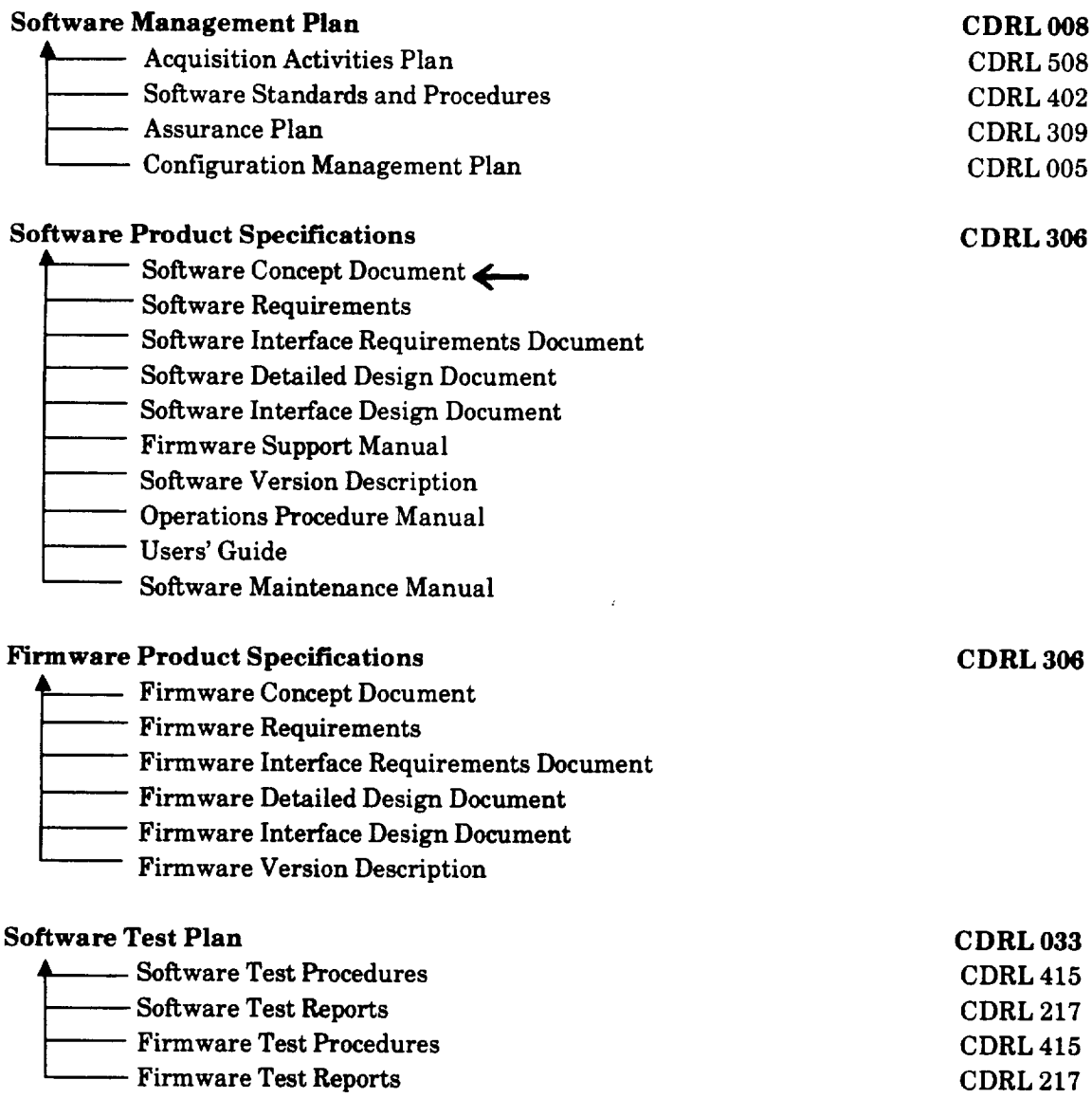


Figure 1 EOS/AMSU-A Software Documentation Tree

Section 2

RELATED DOCUMENTATION

2.1 Parent Documents

None

2.2 Applicable Documents

The following documents are referenced or applicable to this report. Unless otherwise specified, the latest issue is in effect.

National Aeronautics and Space Administration

NASA-DID-P100 Concept Data Item Description.

GSFC 422-10-04 Earth Observing System (EOS) Instrument Project Software Acquisition Management Plan

2.3 Information Documents

None.

Section 3

DEFINITION OF THE EOS/AMSU-A GROUND SUPPORT EQUIPMENT SOFTWARE

3.1 Purpose and Scope

This document presents the concept for two separate but closely related software systems. The first is the Special Test Equipment (STE) software used at Aerojet for AMSU-A instrument testing, and the second is the Workstation software used at the spacecraft integration facility to monitor the AMSU-A instrument when installed on the spacecraft.

The primary use of the STE software is to monitor the data output from the AMSU-A instruments, to command the instruments, and to perform automated thermal-vacuum calibration testing.

The primary use of the Workstation software is to monitor the AMSU-A instrument's performance through an Ethernet link during the instrument/spacecraft integration process.

3.2 Goals and Objectives

The software shall be designed so that it is "user-friendly" in that all menu displays and all operator interactions are clear and unambiguous. Enough information will be presented with each request of the operator so that reference to the User Manual will be minimized. The software will perform all tasks necessary to monitor all required functions, and will perform all required tests.

3.3 Description

The STE software resides in a Digital Equipment Corp (DEC) MicroVax Computer and is interfaced to the AMSU-A instruments through cabling to an Input/Output (I/O) interface circuit board in the computer chassis. The computer is also interfaced to the Calibration Test Equipment Controllers through a serial RS-232 cable set. The operator utilizes a CRT display/keyboard as the primary input/output device with a printer used to produce hard copy data (see Figure 2). The software monitors the status of the AMSU-A instruments during test, controls the instrument operating modes automatically and through operator inputs, controls the laboratory Calibration Test Equipment during test, and performs all the calculations necessary to calibrate the instruments.

The Workstation used at the spacecraft integration facility interfaces with the AMSU-A instrument onboard the spacecraft through an Ethernet interface and monitors the status and data produced by the instrument during test (see Figure 3) .

3.4 Policies

None.

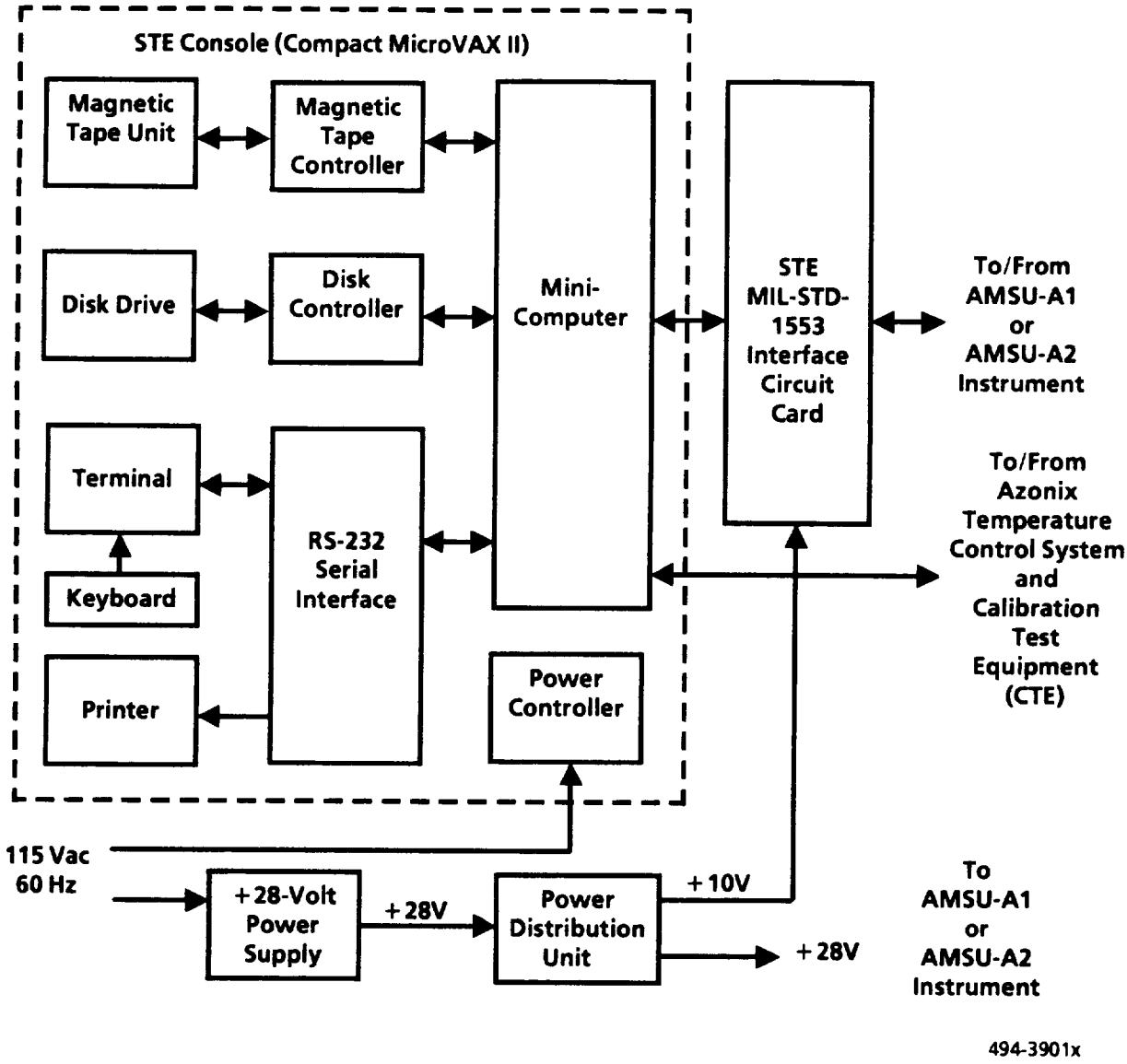
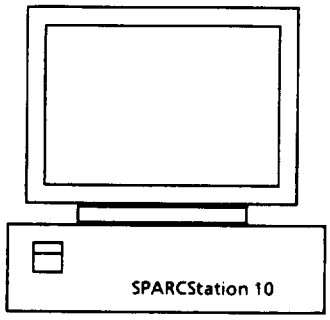


Figure 2 STE Block Diagram



PROCESSOR

Architecture – Super Sparc
Clock rate – 40 MHz
Number of CPUs – one

SYSTEM MEMORY

RAM – 32 MBytes
Disk storage – 2X1.05 GBytes
Internal floppy – 3.5", 1.44 MBytes

I/O ARCHITECTURE

SBus slots – 4
Serial ports – 2
Parallel ports – 1

NETWORK PORTS

Twisted pair Ethernet
AUI Ethernet

Figure 3 Spacecraft Interface Workstation

Section 4

USER DEFINITION

The users of the STE will be test engineers using the commanding and monitoring functions of the software to evaluate the AMSU-A instrument performance during subsystem and system integration. When the instrument has been completed and is ready for environmental and acceptance testing and thermal-vacuum calibration testing, the users will be test and system engineers using the commanding, monitoring, and automated test routines in the software to evaluate the instrument during test and to produce the calibration data from the calibration tests.

The users of the Workstation will be system engineers overseeing the integration of the AMSU-A instrument onto the spacecraft. They will be using the monitoring capability of the software to evaluate the performance of the instrument in the spacecraft integration environment.

Section 5

CAPABILITIES AND CHARACTERISTICS

5.1 STE Software Capabilities

The STE software will provide all the required timing through the MIL-STD-1553 interface to the AMSU-A instrument flight firmware. It will also transmit all commands and data requests to the flight firmware through the MIL-STD-1553 interface.

The software will provide a menu driven display system to the operator allowing a selection from all instrument data to be displayed in real time to monitor instrument performance during integration and test. It will perform automated test sequencing and calibration test equipment control when these functions are selected through appropriate menu entries. The software will perform the mathematical computations required to produce all required calibration results and will store these results on the system disk and print them on the system printer. Whenever the instrument is powered on all data will be taken and stored on the system disk to be later archived to tape if required.

5.2 Workstation Software Capabilities

The Workstation software will provide test personnel with the ability to monitor all data provided to it through the Ethernet interface by the use of menu entries and displays.

5.3 STE Software Characteristics

The STE software is written in the Fortran language with a hierarchal structure composed of approximately 100 subroutines. The modular structure ensures ease of maintainability and expansion. Approximately 25 percent of the subroutines in the existing software will be modified to incorporate the new MIL-STD-1553 and related interface changes. The software subroutine name convention utilizes a numbering system to place each subroutine in its proper place in the overall hierarchy. For example, the AMSU-A1 initialization subroutine is named A1_1000_INITIALIZATION and the data collection subroutine is named A1_3000_COLLECT_DATA. The number series, corresponding executable lines of code, and related functions for each of the two CSCI (A1 & A2) are:

Series	Lines of Code	Functions
1000	700	Initialization
2000	1000	Main Menu and instrument setup
3000	3400	Data Acquisition and operator display
4000	1400	Test setup and procedures
5000	1300	Data reduction and Test Result displays
6000	500	Data Playback
8000	500	Self Test
9000	1400	Input and Output Interrupt and Handler routines

The changes required because of the EOS/AMSU-A modifications will be mainly in the 3000, 8000, and 9000 series routines. No changes are expected in the 4000, 5000, and 6000 series subroutines, and only minor changes will be necessary to the 1000 and 2000 series. The 8000 series self-test routines will be totally changed as they relate to the existing AMSU-A interface circuit card. The 3000 series data acquisition and 9000 series data input/output routines will require extensive modification, but the 3000 data display routines and the 9000 series, other than data input/output, will not be modified. The estimated amount of code to be changed will be approximately 2500 lines in each of the 2 CSCI for a total of 5000 lines, or approximately 25 percent of the total lines in the existing CSCI.

The STE software has been used for AMSU-A testing for more than 3 years and has adequate memory, CPU, and disk storage capability for its intended use. The conversion to a different instrument interface will not change the data quantities or data rates because these are fixed by the scan speed of the instrument; thus the performance of the modified software will equal that of the original. The data structure will change at the input/output subroutine level only and will be maintained in the original form throughout the remainder of the program. The interfaces to the software consist of the operator terminal I/O, printer output, system disk I/O, three RS-232 I/O ports to the calibration test equipment and one RS-232 input port from the "power-off" platinum resistance thermometers (PRT) in the instrument, and the MIL-STD-1553 interface to the AMSU-A instrument.

The software has extensive error reporting capabilities, will recover from any instrument data error automatically and will not permit operator input errors to adversely affect software operation or instrument function.

5.4 Workstation Software Characteristics

The Workstation software utilizes the OASIS/CSTOL programming environment to acquire and display the AMSU-A instrument data while integrated with the spacecraft. The input data bases will be populated so as to define every input element and its location within the data stream received from the spacecraft integration computer system. All AMSU-A data are classified as either Engineering data or low-speed science data. No AMSU-A data will be included in the high- speed science data stream. Because of its location within the Engineering data stream and the low- speed science data stream, all AMSU-A data will be available for display and evaluation on the Workstation display. The OASIS/CSTOL environment will be used to define all the display windows required, together with the virtual push buttons necessary to select the desired windows.

Because of the relatively slow data rate from the AMSU-A instruments, the OASIS/CSTOL environment will meet all performance requirements. Because the Workstation functions as a "listen only" device, no commands or test procedures will be included in this software. Since it is planned to include displays of all AMSU-A data in the initial implementation, no program flexibility or expansion will be necessary although these features are inherent in the OASIS/CSTOL environment and could be utilized if required.

Section 6

SAMPLE OPERATIONAL SCENARIOS

6.1 STE Operation

The following scenario will take place during AMSU-A instrument calibration in the thermal-vacuum chamber.

From the Main Menu display the operator will input the instrument serial number. This will cause the program to load the database tables corresponding to that unique serial number into computer memory. The operator will then select the Commands Menu, and by selecting appropriate commands will configure the instrument for the tests to be conducted. The selected commands will be transmitted to the instrument and verified utilizing the corresponding feed-back signals. When the operator is satisfied that the instrument is configured properly, he will select the test(s) he wants to perform.

From the resulting test menu display, he can choose to run the test using all the criteria displayed, or he can change any of the test setup values prior to initiating the test. When the test setup values are as desired, he will select the "start transition" entry which directs the computer program to begin configuring the calibration test equipment to the desired states and temperatures. The operator will use the monitor display menus to ascertain when the test equipment temperatures have reached equilibrium, and then will select the "START TEST" entry. The computer will open a test data file and begin data acquisition. Upon completion of the selected number of scans, the test will automatically terminate, all required computations will be performed, and the results will be displayed. During all instrument powered-on monitoring and testing all possible error conditions will be continuously evaluated by the computer. All error messages relating to test equipment conditions and instrument status will be displayed and logged to an error log. At any time, either in monitor mode or during test data acquisition, the operator can request a real time print out of the display screen onto the system printer. In addition to the test data file recorded on the system disk file, all data are recorded to the disk for anomaly evaluation should such anomaly occur. Capability will be provided to playback test data files and other background data files.

6.2 Workstation Operation

When the Workstation is connected to the AMSU-A instrument through the Ethernet connection from the spacecraft integration facility computer, the operator will be able to select any portion of the AMSU-A data frame to monitor by selection from a menu list. Instrument status will be monitored by the program and error conditions will be reported on the display. Since this is a "listen only" station it will be limited in scope to acquiring the data, formatting data for display, and evaluating instrument health status.

Section 7

ABBREVIATIONS AND ACRONYMS

AMSU-A	Advanced Microwave Sounding Unit-A
CPU	Central Processing Unit
CRT	Cathode Ray Tube
CSCI	Computer Software Configuration Item
EOS	Earth Observing System
I/O	Input/Output
MHz	Mega Hertz
MIL-STD	Military Standard
NASA	National Aeronautics and Space Administration
PRT	Platinum Resistance Thermometer
STE	special test equipment

Section 8

GLOSSARY

None

Section 9

NOTES

None

Section 10

APPENDICES

None

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